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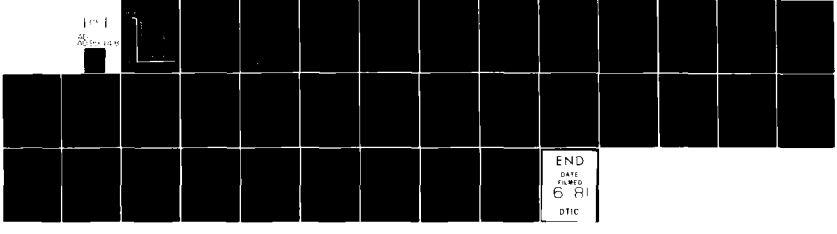

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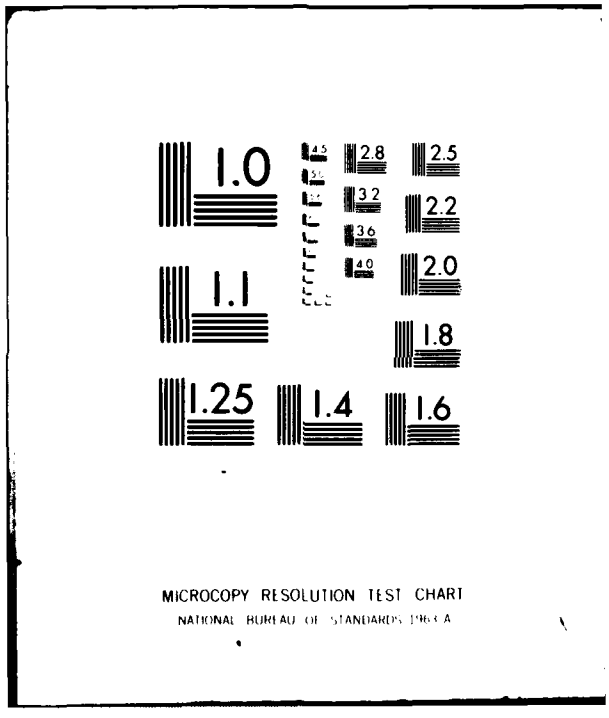
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AIR FORCE HUMAN RESOURCES LABORATORY

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FORMAT OPTIONS AND PROCUREMENT OF TECHNICAL ORDERS

By

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Logistics Research Branch
Wright-Patterson Air Force Base, Ohio 45433

May 1981

Final Report

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235

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This report was submitted by BioTechnology, Inc., 3027 Rosemary Lane, Falls Church, Virginia 22042, under Contract F33615-78-C-0016, Project 1710, with the Logistics and Technical Training Division, Air Force Human Resources Laboratory (AFSC), Wright-Patterson Air Force Base, Ohio 45433. Robert C. Johnson, Personnel and Training Requirements Branch, was the project engineer. Contract technical monitors were SMSgt Edwin G. McFall and, later, SMSgt Robert Guy.

This report has been reviewed by the Office of Public Affairs (PA) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nations.

This technical report has been reviewed and is approved for publication.

ROSS L. MORGAN, *Technical Director*
Logistics and Technical Training Division

RONALD W. TERRY, Colonel, USAF
Commander

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format selection	Job Performance Aids (JPA)	TO procurement
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FOSDIC	maintenance procedures	validation/verification

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report outlines research leading to the development of the guidelines for selection of format options and procurement of technical orders (T.O.). Previous research by Air Force and other DOD agencies has resulted in the development of several improved techniques for creating, and formats for presenting, technical data for maintenance. Application of these techniques and formats for operational use has been hindered by the fact that technical data managers frequently do not have sufficient information on the improved techniques and formats to allow them to procure the improved data. This report documents the development of guidelines and an information source to fill this need.

A thorough review of the state of the art in developing, presenting and procuring technical data was

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accomplished to provide the basis for developing the guidelines. This was accomplished first by reviewing available formats, specifications, and applicable literature and then by conducting extensive interviews with government and industry personnel who are knowledgeable of, and experienced in, current technical data procedures. The next phase involved analysis of these data, the selection of candidate formats, the development of descriptions of the formats, development of criteria for selecting formats, and development of guidelines for procuring data.

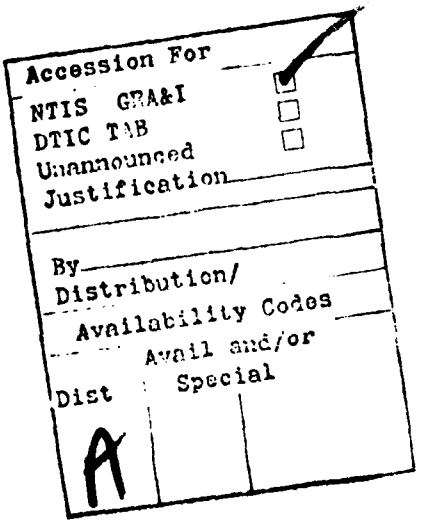
The preparation of the T.O. managers guidelines was governed by identified informational needs as well as by information available for inclusion. Other considerations in developing the guidebook were the arrangement and organization of the documents for maximum usefulness, provision of information in an optimal format and level of detail, and inclusion of features to preclude premature obsolescence. The guidebooks are a practical reference document, which deal both with the normal process of T.O. development and acquisition and with considerations for selection of format-based techniques. The information is presented in a manner that assists the T.O. manager with decision making but does not limit that decision capability.

PREFACE

This report has been prepared by BioTechnology, Inc., 3027 Rosemary Lane, Falls Church, Virginia 22042. It is the culmination of work accomplished for the Logistics and Technical Training Division, Air Force Human Resources Laboratory (AFHRL), Wright-Patterson AFB, Ohio, under contract F33615-78-C-0016 during the period May 1978 to May 1980.

The authors express their appreciation to SMSgt Edwin G. McFall and his successor SMSgt Robert Guy, both of AFHRL, for their support and guidance during the performance of this effort, and to Robert C. Johnson, AFHRL, for his patient consultation and knowledgeable direction. Acknowledgement must also be made of the contributions of the many individuals in the Air Force, the other military services, and in industry, who shared with the authors their expertise and experiences of developing and acquiring technical publication data.

The BioTechnology Program Manager for this effort was Harold E. Price, and G. Richard Hatterick was Principal Investigator. The authors are also indebted to Theodore J. Post of BioTechnology for his consultation and advice regarding procedural data formats.



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SECTION 1. INTRODUCTION AND BACKGROUND

1.1 INTRODUCTION

Procedures for the operation and maintenance of U.S. Air Force (USAF) equipment and systems are contained in publications called Technical Orders (TOs). A formal Technical Order System is operated to guide the acquisition and preparation of new TOs for specific programs, to control the distribution of TOs to organizations having a need, and to manage the TOs throughout their life cycle. In order to acquire TOs for new programs, a Technical Order Management Agency (TOMA) is established within the organization having acquisition responsibility, headed by a TO Manager.

This report documents a study conducted by BioTechnology, Inc., for the Air Force Human Resources Laboratory (AFHRL) to develop guidelines for selection of format options for procurement of technical data. The guide that has resulted from this effort has been prepared, in two volumes - AFHRL-TR-80-50 and AFHRL-TR-80-51, to be a basic reference publication. It is intended for use by all individuals involved in the acquisition and management of USAF TOs, with emphasis on the responsibilities and concerns of the TOMAs in those commands acquiring TOs. The scope of the guide includes a review of the USAF TO System, extensive descriptions of procedural data formats, guidelines for determining formats to satisfy particular user needs, and guidance in various aspects of TO procurement, development, and management.

It is necessary that such a document be responsive to the changing needs of the USAF and the transfigurations in procedural data techniques that are continually occurring. It has therefore been prepared with the intention that it will be periodically revised and updated to prevent it from becoming obsolete. Subsequent issues can incorporate new information, reflect changing policies and regulation, and correct deficiencies and errors which may have been made during the preparation of earlier versions.

1.2 BACKGROUND

1.2.1 BACKGROUND AND ISSUES. Since the military draft ended and the all-volunteer force (AVF) was started, there has been a significant change in the characteristics of personnel in the military service. The arguments over the effects of this change are intense, but no matter how these arguments and the statistics are reviewed, there are military personnel performance problems. All services are, therefore, looking into many approaches to achieve and maintain personnel performance within the climate of the AVF. This includes maximizing the use of job performance aids (JPAs).

It has been recognized for many years that TOs were not always adequate. Historically, the content and format of TOs has been dominated by engineering data and printing considerations and only modest attention to user needs was evident. In order to compensate for limitations in the maintenance manual, the services typically conducted extensive training programs. Today, however, it is frequently asserted that the performance potential required of the TO is widening because of problems such as:

- Unit training costs are increasing, while budgets are decreasing.
- Personnel costs are increasing.
- Equipment maintenance costs are increasing.
- Material readiness is decreasing.
- Entry level skills are decreasing.
- System/equipment complexity is increasing.
- Personnel turbulence—turnover—is increasing.

The performance achievement essential to USAF technical jobs has traditionally been obtained through selection and training, and occasionally through an emphasis on human engineering. Technical manuals have served more as a backup. However, there is now a distinct willingness on the part of Director of Defense Research and Engineering (DDR&E) and USAF policymakers to give TOs a greater role. Perhaps this new willingness has emerged because nearly 60 percent of total life cycle costs is attributable to personnel, or because the enormous costs of training are being scrutinized by both Congressional and Executive Branch watchdogs. The Department of Defense (DOD)-wide costs for formal training now exceed $7 billion per year; it has been established that on-the-job training (OJT) and other training cost twice that amount. Thus, there is a strong interest in deferring the heavy investment in front-end training for new recruits until military career interests and potential have been established.

However, without this front-end and continued training, new technicians cannot use traditional TOs. A potential solution to this dilemma is to utilize innovative TO formats that can obtain performance from relatively untrained technicians, i.e., invest in the "book" rather than the "head."

1.2.2 JPA RESEARCH. Selecting the proper format or, indeed, even knowing what formats exist is a task for which TO Managers have not been prepared. Extensive documentation of formats exists, the result of over 20 years of JPA research, but it is rarely in a form that is useful to a TO Manager.

The Air Force Personnel and Training Research Center (a predecessor of AFHRL) was in the forefront of this research, experimenting with "behavioral guides" as a means of improving manpower utilization and maintenance effectiveness in the mid-1950s. Since that time, all branches of the military, major systems contractors, and several independent research and development (R&D) organizations have been engaged in job performance aids research. In one sense the effort could be considered *overly* successful; over 100 novel formats or techniques have been generated that purport to replace, supplement, or redesign conventional TOs. These techniques include not only formats, but diagnostics, delivery systems, media utilization, and training approaches.

Unfortunately—but not surprisingly—not all of these prospective innovations have been useful. Some have only been minor variations from conventional techniques. Some have been so esoteric as to be impractical. Some have been tested and some have not, but few have been implemented.

The lack of implementation of new TO formats is surprising, considering the promise shown by the research and development efforts. A review of some of the critical research and a relaxing of

scientific rigor in the interpretation of results allows sweeping generalizations to be made with respect to past technical data R&D results, as is presented in Table 1-1.

Table 1-1.—Reports of Data Format Tests Reported by Various Researchers

DATA FORMAT TESTS (EXAMPLES):

- **FAVORABLE RESULTS:**
  - **SPARES UTILIZATION.....REDUCED 30%**
  - **MEAN TIME TO REPAIR (MTTR).....REDUCED 40%**
  - **ON-LINE MAINTENANCE MAN-HOURS.....REDUCED 33%**
  - **FAULT ISOLATION TIME.....REDUCED 36%**
  - **FORMAL TRAINING TIME.....REDUCED 50% TO 80%**
- **UNFAVORABLE RESULTS:**
  - **LESS ACCEPTABLE TO EXPERIENCED TECHNICIANS**
  - **SUPERVISORS ARE SUSPICIOUS**
  - **FRONT-END COSTS ARE INCREASED**

Even though these results may not apply to all systems under any conditions, the "evidence" from prior research is formidable enough to justify better utilization of the results. This is not to say that all results have been favorable; indeed, there have been problems with innovative TOs. Nevertheless, thorough researchers have identified the problems as well as the potential benefits, and the total spectrum of results can be considered in selecting formats for USAF TOs.

1.2.3 **RESEARCH PAYOFF.** When considering the topic of technical data research, it is reasonable to speculate on the projected payoff from utilizing some of this past research. Organizations within the Air Force, Army, Navy, and DDR&E have endorsed the statement that the use of innovative formats can have valuable payoffs such as those indicated in Table 1-2. For example, paragraph 1.6 of AFSCM 310-2 (Technical Publications Acquisition Manual) states:

> *New methods for technical publications.* In the early stages of the program, the SPO [System Program Officer] should consider new techniques for presentation of maintenance and operations information. He will review such new techniques for application to his program as a supplement or replacement of existing publications.

Table 1-2.—Projected Payoffs and Impacts of Innovative Formats

PROJECTED PAYOFF: USE OF INNOVATIVE JPAs CAN...

- DECREASE TRAINING COSTS
- INCREASE PRODUCTIVITY OF ENTRY LEVELS
- INCREASE CAREER FORCE CANDIDATES
- DECREASE SPARES UTILIZATION
- DECREASE MAINTENANCE LABOR FORCE
- DECREASE MAINTENANCE PERSONNEL COSTS

PROJECTED IMPACT: ACHIEVEMENT OF PAYOFF REQUIRES...

- INCREASED INITIAL INVESTMENT
- IMPROVED REQUIREMENTS ANALYSIS
- INCREASED DATA ACCURACY
- MORE T.O. MANAGER EXPERTISE

No new research is needed to develop new formats. The problem is how to encourage and facilitate the serious consideration of available format options by the TO Manager in the SPO. The potential benefits will never be realized unless the institutional users (TO Managers) are aware of specific formats, their benefits, and their impact. Furthermore, the TO Managers must be prepared to present the case for new formats in terms of their payoff and impact on other USAF agencies within Air Force Logistics Command (AFLC), Air Force Systems Command (AFSC), the using command, and Air Training Command (ATC).

1.3 STUDY PURPOSE AND OBJECTIVES

1.3.1 IDENTIFICATION OF NEEDS. The TO Manager for a System Program Office (SPO), normally in the AFSC, has a difficult and demanding job. In coordination with TO representatives of AFLC and the major command involved, the TO Manager must select the best type (format) of TOs available. The type selected should meet the needs of the specific weapon system involved, as well as the needs of the technicians who will use the data. Many different formats, and options within each format, have been developed. Most formats have specific strengths and weaknesses. Careful selection and application of format types is necessary in order to get maximum benefit from the positive features of each one. However, information has not been available to assist the TO Manager in determining user requirements, or in selecting the best available format to fulfill the requirements.

Research results from AFHRL and from other Air Force, Army, Navy, and industry organizations are sometimes not readily available to TO Managers. Often the information is not in a usable form when it does become available. The task of locating, evaluating, and applying the TO-related research results of the various Government and industrial organizations exceeds the time available to most TO Managers.

Once the proper format has been selected, another difficult aspect of the TO Manager's job begins—that of procuring the best possible technical data from the contractor. Although considerable research has been done on improving the processes for developing technical data, this information is not readily available to the TO Manager in a concise, usable form. A need exists for a guide to identify the available format options and suggest guidelines for selecting formats to fit specific system and user needs. The document should consolidate the appropriate information in one publication, in a format and style readily usable by USAF TO Managers. It should include information that will enable better management of a TO development contract, as well as information on implementing and using new TOs in the field.

It was hypothesized that a guide with the above characteristics would improve the quality of TOs by making research and experimental information available to the TO Manager, along with a consolidated description of the requirements of the TO System.

1.3.2 OBJECTIVES. This report and the companion guideline publications were developed under contract to AFHRL in response to the identified need. The study which led to their publication was fully coordinated with, and cosponsored by, AFLC.

The purpose of this project, conducted by BioTechnology, Inc., was to assemble information that would be useful to Air Force TO Managers and other personnel concerned with acquiring technical data for use in developing TOs. To that end, three distinct objectives were established. These were:

a. To identify TO acquisition requirements and problems, along with existing formats and guidelines.

b. To determine the specific information, requirements, procedures, and guidelines that should be made available to the TO Manager.

c. To develop a handbook of data and procedures for requirements determination; format selection; and acquisition, development and implementation of Air Force TOs.

The approach to meeting these objectives was, first, to gather information relating to the needs of TO Managers by interviewing TO professionals from both the Air Force and private industry. This stage of the work also included a review of available formats, specifications, and applicable literature. The second phase involved analysis of these data, with the selection of candidate formats and guidelines and the development of additional guidelines. Finally, the text and introductory presentation materials were prepared.

The activities, findings, and products of these three phases are briefly described in the following sections.

SECTION 2. PHASE I—INFORMATION GATHERING

The initial phase of the project comprised three tasks, all involving the gathering of information:

- Task 1 Interview TO Managers
- Task 2 Identify available formats and specifications
- Task 3 Review literature for potential material to be included.

2.1 INTERVIEWS WITH T.O. MANAGERS

2.1.1 PREPARATION. This initial task was for the purpose of determining from representative Air Force TO Managers what the real-world problems of TO acquisition are, and the types of materials that would be most useful.

Briefing materials were prepared which included an interview protocol, specific topics to be addressed, a description of the project background, and a preliminary outline of the guide. Other materials included a preliminary list of specifications relating to technical manual formats, and summary reports of two field tests of JPAs conducted by AFHRL.

Primary objectives were to determine:

- *Events of the Development Process* The documentation should emphasize key events of the process, e.g., Technical Order Requirements Conference (TORC).
- *Organizations Involved in the Process*—The documentation should include organizations responsible for major products or events, e.g., Oklahoma City Air Logistics Center (OC-ALC) as the USAF TO distribution center.
- *Inputs and Products* The document will identify inputs which precede, and products which result from, each event of the TO development process, e.g., Maintenance Philosophy is the product of the Integrated Logistics Plan and potentially serves as an input to the TORC.
- *Specifications and Policies*—Where possible, each event, product, or input of the process will be keyed to a policy, specification, or handbook which describes its purpose, characteristics, or use.

2.1.2 INFORMATION SOURCES. Initial planning anticipated discussions/interviews only with TO Managers in various AFSC SPOs. As a result of early technical discussions with AFHRL project monitors, it was agreed that representative contractor TO Managers, under a "matched-pair" concept, should be included. This approach would ensure that the guide would reflect an appreciation of the problems, capabilities, and limitations of TO contractors. Subsequently it was also determined that data collected would be incomplete, and probably biased, without inputs from TO management personnel in the AFLC. As a result, interviews were held with TOMA personnel in three divisions (Aeronautical Systems Division (ASD), Electronic Systems Division (ESD), and Space and Missile Systems Division (SAMSD), two AFLC centers (WR-ALC and OO-ALC), Strategic Air Command (SAC), and four contractor organizations (Raytheon, Autonetics, Boeing, and TRW, Inc.). Discussant organizations are identified in Table 2-1, together with the program areas

involved. All discussants were very open and cooperative, and significant quantities of reference materials from these ongoing programs were obtained. In addition, the project team participated in a conference of AFSC/ASD TO management personnel where many project-relevant problems were discussed, and in a Technical Manual Symposium sponsored by the National Security Industrial Association (NSIA).

Table 2-1.—Information Sources, TO Manager Interviews

SYSTEM	AFSC			AFLC		SAC	CONTRACTORS			
	ASD	ESD	SAMSD	WR-ALC	OO-ALC		RAYTHEON	BOEING	TRW, INC.	AUTONETICS
PELS	●									
F-15 AIRCRAFT	●									
PAVE PAWS		●					●			
MINUTEMAN			●		●	●		●	●	●
MX			●			●			●	●
GENERAL	●			●	●					

2.1.3 **FINDINGS OF T.O. MANAGER INTERVIEWS.** As a result of these interviews and discussions, a number of significant findings emerged, plus some which were not in the mainstream of this project. Each of these findings, however, had an influence on what was to be included and how that material was to be presented. The most significant findings are discussed here.

a. *Potential Users*: The population of potential users of the guide is much broader, and more varied, than had been anticipated. An Air Force TO Manager may be military (officer or noncommissioned Officer (NCO)) or civil service; in some instances, the user may be a support or technical integration contractor. The range of prior experience with acquisition of TOs is from zero to more than 20 years. The guide is likely to have greatest utility for the relatively inexperienced TO Manager assigned to relatively small programs, and may also be of value to Data Managers, who often initiate the TO acquisition process before a TOMA is established.

b. *User Needs*: Because of the variations among potential users, and also because of the differences in orientation and structure between AFSC divisions, needs are not constant between sets of potential users. Knowledge about alternative TO formats is not widespread among potential users. More specifically, contractor personnel often appear to be

more aware of the full range of possible format options than do AF personnel. Partially as a consequence of unfamiliarity, AF personnel spend little time in considering format questions. Their main preoccupations are with such issues as their role responsibilities and prerogatives vis-a-vis other elements within the Air Force and vis-a-vis the contractor. Given the explicit scope of the present project, the most relevant needs are for descriptions of options, the sanctions for selection in official DOD documentation, and elementary guidelines on the relative benefit and cost aspects of each set of options. Cost relationship guidelines will, however, be the most difficult to provide due to the unavailability of reliable cost data on acquisition of TOs, conventional or otherwise.

c. *Aspects of Statement of Work (SOW) Preparation*: Again, practice varies, but in some instances it is possible for the SOW to be prepared prior to the establishment of a TOMA within the SPO. The Data Management or Logistics Management staffs frequently undertake this function as part of the overall procurement planning process. In other instances, the TOMA prepares the SOW or can be involved in substantial dealings with the prime contractor in the form of interpretations of the specifications. Finally, in some instances the SOW for TO procurement is delayed until well after the prime contract has been let. In such circumstances, the system contract agreement contains only a general (standard) reference to TO development.

The main point raised by interviewees was that it is necessary for the TO Managers and their counterparts in Logistics and the user commands to have a good, basic knowledge of the overall procurement process including the allowable variations among divisions in AFSC in order to understand how the SOW for TO procurement fits in. Further, it must be recognized that SOW preparation is an iterative process, becoming more and more definitive as system hardware development progresses.

d. *Management Procedures During TO Development*: The techniques for in-process and pre-/post-publications reviews, validation, and verification also vary across systems. A principal factor is the nature of the relationship between the SPO and the prime contractor. In some cases, particularly those in which the agreements have been in force over an extended period, the decisionmaking activity can be collaborative. While there are instances, according to respondents, of prime contractors exploiting the ambiguities of TO procurement, the general impression is that such collaborative arrangements are constructive for the basic reason that the contractor personnel tend to be more permanent in their roles and can provide forms of technical expertise that, in effect, help the TOMA deal with the intricacies of the process.

One such intricacy reported more than once is the conflict between the increasingly frequent objective of 100 percent verification and the availability of resources to conduct such a process. The ingredients required for 100 percent verification are validated procedures, actual system hardware, representative user personnel, and participation (monitoring of tests) by appropriate representatives of all Air Force commands that are parties of interest (i.e., Logistics, Systems, and the user). The "clout" to bring all of these elements to bear in one place in a timely manner was perceived to be missing by many of the respondents.

e. *Implementation of TOs in the Field*: A number of particular problems are associated with implementation of TOs, but there appear to be two main generic issues. First, there is the general ambiguity about the boundaries of responsibility between the SPO and the counterpart Logistics Command unit. To some degree, this ambiguity can extend into the domain of the prerogative of the user command. In some cases, special elements of the user command have initiated revisions to the TOs provided for what are reported to be parochial reasons. Conversely, user commands feel that, too often, the TOs are inadequate or inappropriate for the technicians who must use them.

The second generic factor is closely analogous in that it is reported that the formal mechanisms for improving TOs (e.g., via the AFTO Form 22) do not function particularly well. However, no respondent offered any alternative method for attaining corrective responses from user personnel.

f. *Selecting Format Options*: Most of the respondents seemed predisposed against inclusion of non-standard formats. Reasons were quite variable, but most often mentioned were:

- "Formats" are too costly to prepare and/or maintain;
- Conventional TOs are just as effective if "properly written";
- Errors in "format" TOs are more serious because the technician has no latitude to work around problem areas;
- New formats are not well accepted by using personnel;
- The TOMA has no latitude to specify formats not encompassed by existing AF specifications.

g. *Overall Summary*: Most of the problems articulated by respondents pertain to matters that are formally beyond the scope of the present project. Amelioration would involve policy modifications at the Air Staff level in some cases. It is pertinent, however, to emphasize such factors as:

- The TOMA is susceptible to relatively rapid turnover of personnel;
- There exists no specific job description for TOMA personnel—it is not widely recognized as a career-relevant assignment;
- There are some general but no specific qualifications involved in the assignment of an individual as TOMA;
- The problem environment for the TOMA is considerably broader than that of selection of alternative TO formats;
- Both continuity and effectiveness of TO procurement require explicit considerations of TO development as early in the development cycle as possible;
- Authority and responsibility for TO effectiveness are not lodged in any single organization during the entire life cycle of the system.

These are not the only conclusions that are possible to assemble from the exchange with the respondents contacted. However, they constitute some of the issues that should help make the guide as relevant as possible to the user community.

2.2 IDENTIFY AVAILABLE FORMATS AND SPECIFICATIONS

The second task of the information gathering phase was directed toward identifying the "formats" which were potential candidates for inclusion, and the specifications or other guidelines to support their preparation.

2.2.1 FORMAT IDENTIFICATION. *Potential formats* were identified starting with prior surveys of JPA techniques, the most recent of which carried the traditional list of 100 JPAs (*Ref. 1*). This list was expanded and supplemented through a review of research reports and through interactions with sources in the military, other government agencies, and industry.

In order to determine which techniques were potentially valid formats for the guide, each was screened and categorized as to its principal character (e.g., format versus media), and the existence and availability of descriptive information, test data, and preparation guidelines.

Illustrated in Figure 2-1 is an excerpt from the listing prepared during this task. The techniques were listed by acronym and abbreviated title; where none existed, an abbreviation was arbitrarily assigned. The "bullets" in the character columns indicate the principal character of the technique, and an "X" designates significant, but not principal, characteristics.

The next three columns show the findings relevant to the other screening criteria: descriptive data, test data, and guidelines for preparation. Any format-based technique which had all three types of data was designated a potential candidate for inclusion. Those techniques that were not format-based, or that were definitely lacking in one or more types of data, were eliminated. The initial listing of possible format candidates was expanded significantly during the requirements analysis phase as more was learned about the format-based techniques. The complete listing is incorporated in AFHRL-TR-80-51.

SHORT TITLE*	TITLE/DESCRIPTION	SOURCE/SPONSOR	CHARACTER** FORMAT*	MED A	DELIVERY	DIAGNOSIS	TRAINING	DESCRIPTIVE DATA*	FIELD TEST DATA*	GUIDELINE/ SPEC*	HANDBOOK CANDIDATE*	NUMBERED NOTES
AUTOTEXT	Automated Text Publication System	Lockheed/USN & USAF			●			Yes	Unk.	Unk.	No	33, 34; 83;
AV/IPU	Audio Visual Industrial Production Unit	Litton	X	●				Yes	Unk.	Unk.	No	12, 85; 86;
AVIS	Audio-Visual Information System	Bell Labs/U.S. Army	X	●		X		Yes	Yes	Unk.	No	8, 86;
BA	British Algorithm	British Air Force	?					Yes	Yes	Unk.	Yes	97;
BAMAGAT	Block-A-Matic-A-Gram-A-Text	Hughes Aircraft	●	X			X	Yes	Unk.	Unk.	Yes	13, 31; 62, 70, 97
BFIC	Binary Fault Isolation Chart	Westinghouse/Nav. Avion. Fac	●					Yes	Yes	Yes	Yes	14, 15, 16;
BFTA	Block Form Troubleshooting Aids	AFHRL	●					Yes	Yes	Unk.	Yes	17, 96, 97;
BSD	Blocked Schematic Diagram	(Unknown)	●					Yes	Yes	Yes	Yes	87, 92;
C-141	C-141 Aids, C-141 Job Guides	USAF	●					Yes	Unk.	Unk.	Yes	5,97;

Figure 2-1.—Sample of Format Identification Data

2.2.2 SPECIFICATIONS AND GUIDELINES IDENTIFICATION. The second portion of this task dealt with the identification of specifications and guidelines documents. Initially, effort focused on references in the format literature and inclusion in the LOLMP Specification List Exhibit. This was expanded, based on information obtained during TOMA interviews and references in Data Item Descriptions (DIDs), Air Force Acquisition Documents (AFADs), and other specifications. A complete analysis of the listings in the Department of Defense Index of Specifications and Standards (DODISS) was accomplished in order to identify specifications used by the other services and to determine current versions of specifications referenced elsewhere.

Since, as a result of the TOMA interviews, TO acquisition and management guidelines took on increased importance, guidelines documents of this type were also included. A composite listing of all potentially useful specifications and guidelines documents was prepared, identifying the document and its most recent issue, the services using the specification, and the equipment and manual types for which it was applicable.

Illustrated in Figure 2-2 is an excerpt from the composite listing of specifications and requirements documents. The complete list includes Military Handbooks, Military Specifications, and Military Standards, as well as manuals, regulations, and similar documents applicable to specific branches of the services. In addition, documents from other sources, including research reports, are included if they contain useful guidelines. The major column, headed "Requirements," will be explained under the discussion of specifications analysis in Task 4. The complete listing is incorporated in AFHRL-TR-80-51.

REQUIREMENTS AND GUIDELINES DOCUMENTS				SERVICE APPLICABILITY				EQUIPMENT						MANUAL TYPE		REQUIREMENTS						REFERENCE NOTES
																PREPARER						
NUMBER AND REVISION	SUBJECT	LATEST ISSUE DATE	FSC	DOD	USAF	ARMY	NAVY	AIRCRAFT	MISSILE/SPACE	C-E-M EQUIPMENT	SHIPS	GROUND VEHICLE	OTHER & SUPPORT	OPERATION	MAINTENANCE	ANALYSIS	STYLE/FORMAT	CONTENT	QUALITY ASSUR.	ACQUISITION	JPA FORMAT OPTIONS	
MILITARY HANDBOOKS (MIL-HDBK)																						
MIL-HDBK-242	Writer's Guide for MIL-M-24100B Functionally Oriented Maintenance Manuals (FOMM)	10/74	T	◇		●	●	(a)	(a)	(a)	(a)	(a)	(a)	▲	▲		▲	▲	△		▲	
MIL-HDBK-63038-1	Technical Manual Writing Handbook	5/77	T	◇		●		(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)		▲	▲			▲	48
MIL-HDBK-63038-2	Technical Writing Style Guide	5/77	T	◇		●		(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)		▲					48
MIL-HDBK-275A	Flight Vehicles & Components Lubricants, Fluid & Compounds Selection Guide	6/76	•		●	●	●															32.9

Figure 2-2.—Excerpt from Specification Identification List

2.2.3 **FORMAT/SPECIFICATION IDENTIFICATION FINDINGS.** The major findings of this task were:

- There are more acronyms than there are JPA techniques; some techniques are merely renamed older techniques; and some are not techniques at all (several were periodicals directed to maintenance technicians).
- A small proportion of the listings are format-based techniques, although many have some significant format characteristics. Most format-based techniques are combinations of different formats. Some of these are included in the listing in their own right.
- Relatively few formats are supported by test results or preparation guidelines. One of the more interesting revelations—since tests of most formats compared them to "conventional" manuals—is that there is really no such thing as a conventional technical manual. There was almost as much variation among examples of Conventional Technical Manuals (CTMs) as among format-based JPAs.
- There appears to be a tremendous amount of duplication among and within the military services in creating specifications. Some duplication is inevitable, but some is based on parochialism.
- Perhaps more serious are the number of referenced specifications which turn out to be superseded or canceled, thereby complicating an already difficult task. A related finding is that the AFADs—an integral part of the TO acquisition process—are seriously out of date. In addition, the project team was unable to locate any official documentation which specifically explained how and when to use an AFAD.
- Finally, there were entirely too many specifications and related publications to be considered, forcing the team to concentrate on those believed to be most significant.

2.3 REVIEW LITERATURE FOR POTENTIAL HANDBOOK MATERIAL

Task 3 really did not exist as an independent task, but was the vehicle for identifying, locating, and conducting an initial review of publications and materials to support other tasks in both Phases I and II. Materials were extracted from documentation prepared in current and past acquisition programs, research reports and papers, specifications and guidelines documents, and Armed Forces policy and regulatory publications.

A comprehensive bibliography was established that includes more than 130 research-type publications used directly in the project; this bibliography is incorporated in AFHRL-TR-80-50 and AFHRL-TR-80-51.

SECTION 3. PHASE II–REQUIREMENTS ANALYSIS

This second phase of the project was based on the data and information collected in Phase I. It included the following specific tasks:

- Task 4–Select candidate formats and guidelines
- Task 5–Develop additional guidelines.

3.1 SELECTION OF CANDIDATE FORMATS AND GUIDELINES

3.1.1 ANALYSIS OF CANDIDATE FORMATS. In Task 4, the initial step was to analyze detailed descriptions, evaluations, and test data for each format-based technique resulting from Task 2. A six-level hierarchy of format considerations was defined, as illustrated in Figure 3-1. Because of the absence of consistent terminology, working definitions for each level were established.

LEVEL	NAME	EXAMPLES
1	JPA SYSTEM	AF/FPJPA
2	PRIMARY FORMAT	MIM
3	FORMAT	JOBGUIDE
4	SUBORDINATE FORMAT	MIF
5	FORMAT COMPONENT	NUMBER-KEYED PHOTO
6	FORMAT ELEMENT	PHOTOGRAPH

Figure 3-1 –Hierarchical Relationships of JPA Technologies

a. *JPA System (Level 1)*–Includes one or more Primary Formats and/or any number of Formats, Subordinate Formats, and Format Components and Elements; may also include "standard" data, media, delivery, diagnostic, and training characteristics and components. JPA Systems encompass a wide range of data applications; for example, operation *and* maintenance, different maintenance levels, or all aspects of maintenance (remove/replace, fault isolation, inspection, lubrication, etc.). JPA Systems are generally well organized approaches, and preparation guidelines are contained in a single specification or group of specifications.

b. *Primary Formats (Level 2)*–May include any number of Formats, Subordinate Formats, and Format Components and Format Elements. May be used with, and may sometimes include, non-format techniques. Primary Formats are generally directed toward a single type of activity (e.g., troubleshooting) and may or may not be part of a JPA System. Primary

Formats are typically complete "packages" requiring little (if any) supporting or supplemental data. In some JPA Systems, Primary Formats are structured techniques for organizing operation and maintenance information according to the type of activity. In such systems, several Primary Formats may utilize the same Format, with different content.

c. *Formats (Level 3)*—These are the basic structures that characterize a particular technique. They result from particular combinations of a limited number of Format Elements into Format Components, then into Subordinate Formats or directly into Formats. In hard copy technical manuals, Formats are often complete on one page or less. The Format is repeated as often as needed, with the technical data changing, throughout the manual. The "traditional" manuals, where the text Format continues through many pages, are no real exception; the Format is repeated on each page (or more frequently), but technical content changes. When testing of JPAs has taken place, it is usually at the Format level, although it may be reported at (and ascribed to) a higher level. A Format presentation must be sufficiently comprehensive to initiate *and complete a task.*

d. *Subordinate Formats (Level 4)*—This is an arbitrarily established category between the Format and Format Component levels. It serves as a place to locate special treatments of Formats to present a particular kind of data. In addition, a Format that is included within another (usually more complex) Format is designated a Subordinate Format for that application. Presentation approaches that are used only to support one or more Formats are Subordinate Formats. Subordinate Formats are not present in some Formats.

e. *Format Components (Level 5)*—Combinations of Format Elements that are insufficiently complete to be called a Subordinate Format or Format.

f. *Format Element (Level 6)*—The basic building blocks of data presentation; e.g., words, photographs, numbers, symbols.

Level 3, the *Format level*, was established as the baseline for analysis, so that techniques at levels 1, 2, and 3 would be considered for the handbook. Next, candidate techniques were documented at each level, and correlation tables were prepared. In both documentation forms, extensive use of symbology reminds the user of the level in the six-level hierarchy.

Characterization of candidate Formats was accomplished by determining the format option characteristics (i.e., level of proceduralization) for various areas of application (troubleshooting, remove/install, etc.), and the applicable use factors (printed materials; information format; sensory channel; personnel factors; types of equipment).

3.1.2 ANALYSIS OF SPECIFICATIONS AND GUIDELINES. The second step of Task 4 was an analysis of specifications and other guidelines documents to identify:

a. those which are presently referenced in the AFADs;

b. those containing requirements and preparation guidelines for format-based techniques;

c. those containing requirements and guidelines for acquisition of technical manual data.

Tables were prepared identifying these factors, and included in the handbook. Figure 2-2, illustrated earlier, is an excerpt from one such table. The requirements column, on the right-hand side of the table, includes identification of the types of requirements imposed on the contractor or other preparer, and notation of whether the specification includes guidelines for data acquisition and for the preparation of JPA formats. This last column designates those specifications which should match up with one or more of the selected Formats, Primary Formats, or JPA Systems.

3.1.3 **INTEGRATION AND SELECTION OF FORMATS AND GUIDELINES.** The third step of the process was to integrate, or match up, the format specifications with the format-based techniques. Figure 3-2 illustrates an excerpt showing the correlation between some of the specifications identified as having format requirements and the format-based techniques that were subjected to the detailed analysis. The complete table covering the techniques/specifications selected for inclusion is incorporated in the handbook.

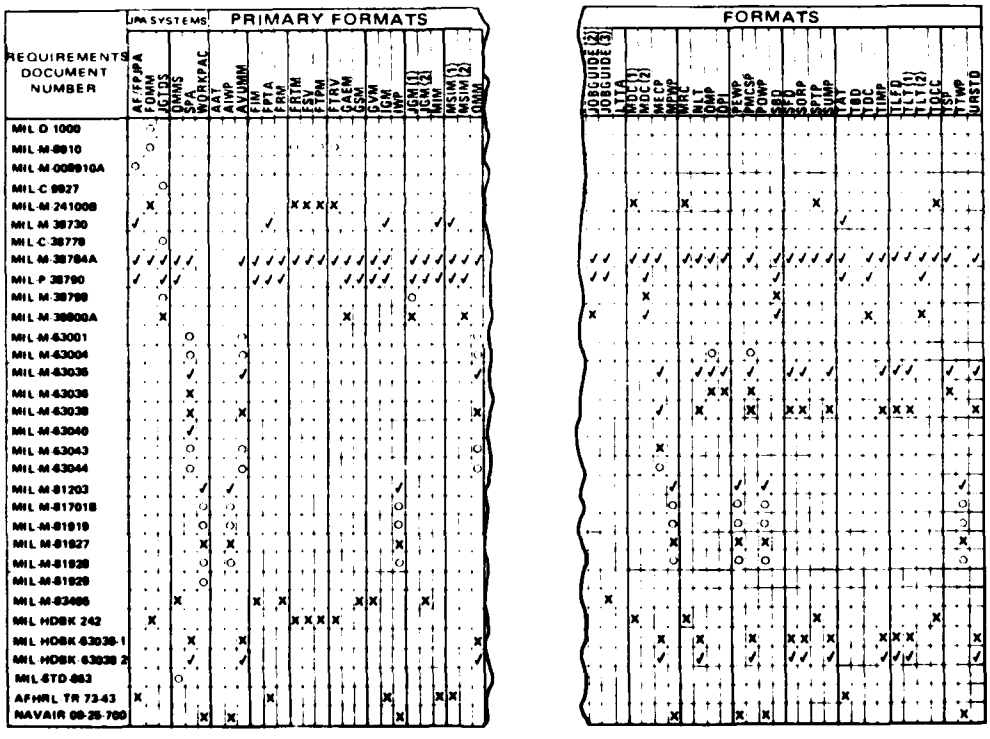

Figure 3-2.—Example of Requirements and Guidelines Documents for the Preparation of Job Performance Aids Format Options

The final step in Task 4 was to determine which format-based techniques should be recommended for inclusion. The ground rules established for this selection began with the techniques that were already determined to be format-based and to have both descriptive data and test data available.

All JPA Systems, Primary Formats, and Formats which could be correlated to preparation guidelines were proposed to be included. In some cases, the Primary Formats and Formats were independent of JPA Systems. In addition, some techniques at each level were recommended for inclusion which did not satisfy all of the selection criteria but which are closely related to a format-based technique that did meet the criteria.

Based on these recommendations, a selection was made by AFHRL of a more limited set of JPA Systems, Primary Formats, and Formats, as follows:

JOB PERFORMANCE AID (JPA) SYSTEMS

- AF/FPJPA – Air Force Fully Proceduralized Job Performance Aids
- JGTOS – Job Guide Technical Order System
- OMMS – Organizational Maintenance Manual Set
- FOMM – Functionally Oriented Maintenance Manuals
- SPA – Skill Performance Aids
- WORKPAC– Work Package Concept

PRIMARY FORMATS AND FORMATS

- AAT – Augmented Action Tree
- JOBGUIDE– Job Guides
- LTTA – Logic Tree Troubleshooting Aids
- MDC – Maintenance Dependency Charts.

3.2 DEVELOP ADDITIONAL GUIDELINES

The final task (Task 5) in Phase II consisted of seven subtasks, as itemized here:

- 5.1 Determining the TO Needs of the User
- 5.2 Selecting the Most Appropriate Format
- 5.3 Suggested SOW Requirements
- 5.4 Management Procedures for the TO Development Process
- 5.5 Implementation of TOs in the Field
- 5.6 Obtaining Maximum Utilization of TOs
- 5.7 Preparation of the Bookplan.

The first two subtasks relate most closely to the format issue. The next four are more closely aligned with TO acquisition, regardless of format. The last subtask was to describe the expected content of the handbook, and is more properly discussed in Section 4.

3.2.1 FORMAT SELECTION DEPENDING ON USER NEEDS. This activity combined the goals of subtasks 5.1 and 5.2 to develop an integrated set of guidelines, based on available methodologies, without conducting any original research.

Finding a method for selecting the most appropriate formats was a key to the development of a useful guide for TO Managers. Analysis indicated that sophisticated algorithms would be useless, even if a valid algorithm was available. Similarly, a "fully proceduralized" aid would leave insufficient decisionmaking capability to the TO Manager.

Consequently, it was deemed appropriate to prepare a general procedural guide that would assist the TO Manager in determining the system conditions which identify certain TO needs, and a similar guide to the elimination of specific format-based techniques which fail to satisfy the TO needs. This process has been termed "Format Option Selection Depending on Interaction of Conditions (FOSDIC)." Although this method differs from any of the proposed selection techniques, it is based in part on the method proposed by T.J. Post (*Ref. 2.3*). The basic steps in the FOSDIC process are illustrated in Figure 3-3.

The guidelines depend heavily on the preparation and use of a topdown breakdown and task identification matrix, preferably prepared by the contractor, as input data. The full description of the process is contained in AFHRL-TR-80-50, Section 6.

The approach to determining the TO needs of the user is based on identifying the relationship between the conditions of a system and the system personnel who would be using the TOs. Different system conditions, such as the time expected for technicians to achieve proficiency, will determine the TO format requirements that will best compensate for that system condition, or have best compatibility with it.

As shown in Figure 3-4, some condition variables will require a specific compensatory format option; other variables can be satisfied by many of the TO format options. Most conditions will be matched to the degree of proceduralization required; some conditions dictate other types of TO needs, such as size, organization, and automation.

The user identifies, for each significant system condition, the variable which applies to that maintenance action and, by extension, the format option indications. Separate guides are available for troubleshooting and non-troubleshooting maintenance actions.

Following the completion of the guide for each maintenance action on each item of equipment, a composite assessment of the format option requirements is made. At this stage, the user is able to consolidate the requirements for each portion of a system for which maintenance actions are needed.

The TO Manager narrows the choices of format options and makes a selection of specific format-based techniques by referring to a series of correlation tables which display the characteristics found in various JPA Systems, Primary Formats, and Formats. The TO Manager then makes a final selection from the format-based techniques that have not been eliminated.

3.2.2 ADDITIONAL T.O. ACQUISITION GUIDELINES. Regarding the SOW subtask, it was determined that the most suitable approach was to provide a guide to the items that should be considered in the preparation of a SOW, description of the methods available for placing requirements on contract, and identification of relevant requirements found in specifications.

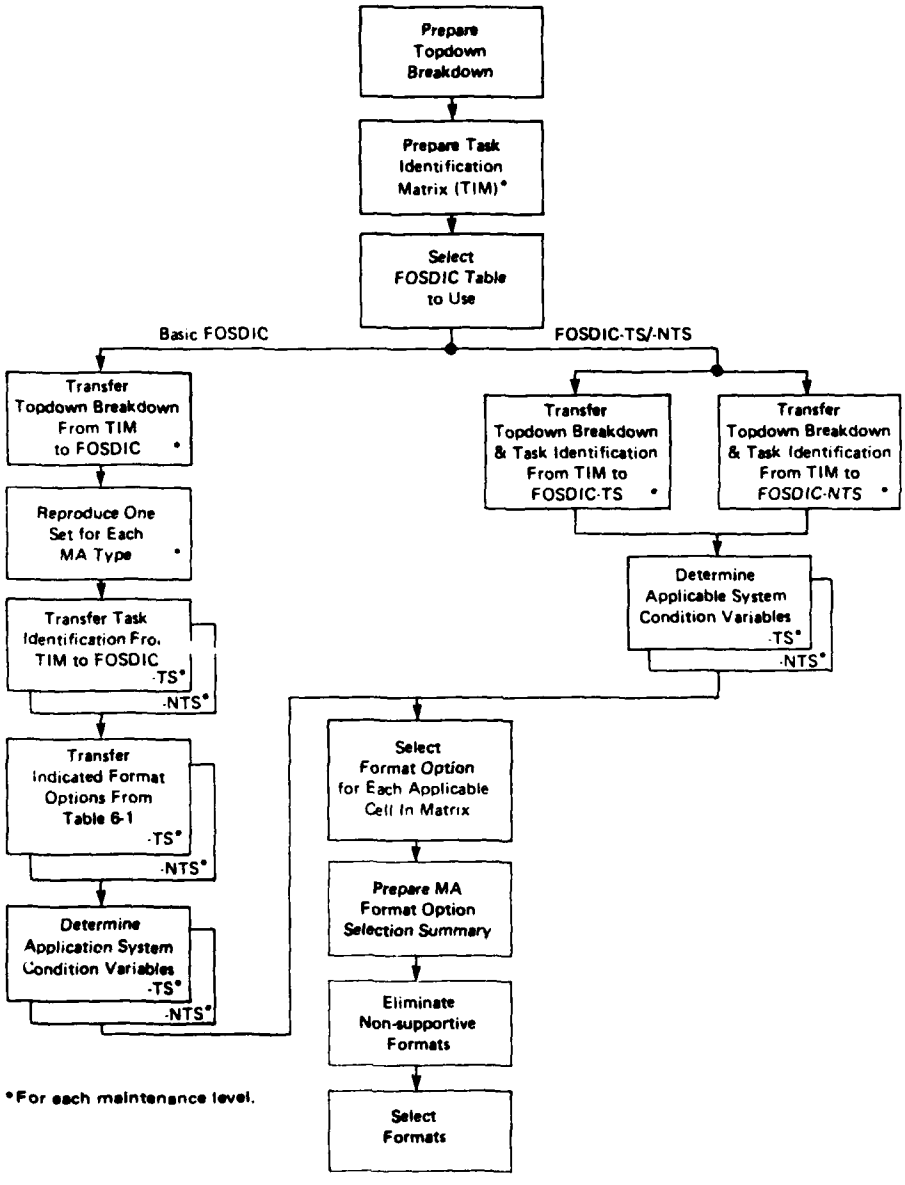

Figure 3-3.—FOSDIC Sequence of Activities

Condition	Variable	Troubleshooting	Nontroubleshooting
Time to Proficiency	Long OJT	Fully proceduralized	Proceduralized
	Short OJT	Deductive	Descriptive

Figure 3-4.—Example of System Conditions Influencing User Needs

The diversity of programs, organizations, and objectives to be satisfied prohibits the development of a "standard" SOW. The specification tables previously mentioned provide some assistance to the TO Manager by indicating which documents contain acquisition requirements. In many cases these specifications contain "ordering data" to guide the TO Manager in determining the specific requirements to be placed on contract.

The Management Procedures subtask focused on three basic areas: (1) TO Management Philosophies; (2) Fundamental TO Management Tasks; (3) TO Management Tools. In all three areas, information was collected from a broad cross-section of specifications and other guidelines documents already in use by the services. In addition, special techniques that are appropriate to the procurement of certain types of formats were included. The approach to coverage of this topic was to consolidate the collected information, making every attempt to clarify ambiguous areas.

Subtasks 5.5 and 5.6 were concerned with identifying and analyzing ways in which TOs, especially those involving unfamiliar formats, can best be introduced to field personnel and with promoting greater utilization of the TOs by such personnel. This topic is somewhat troublesome as far as guidance to the TO Manager is concerned, largely because the acquisition manager has very limited opportunity to interact directly with the field units who will use the TOs. In addition, increased utilization of TOs is actually one of the basic reasons for all of the preceding tasks, and of the project itself. The premise is that improved formats in TOs will both permit and promote increased utilization.

Based on this premise, two approaches were derived. Each area in the handbook that deals with topics known to affect the acceptance and utilization of TOs (such as validation and verification to ensure data accuracy) includes specific reminders of the relationship of that topic to utilization. In addition, a separate discussion is included in an appropriate section of the guide. The guidance in that section is an adaptation of the approach used when Job Guide Manuals (JGMs) were implemented in the C-141A program (*Ref. 4*).

SECTION 4. GUIDEBOOK SCOPE AND CONTENTS

4.1 INTRODUCTION

The ultimate objective of this project was to prepare guidelines that the TO Manager would find useful in all aspects of TO acquisition and management.

Planning for guidebook content and organization actually began with the preparation of the preliminary outline in Task I. During and following the subsequent information-gathering and analysis activities, the team considered the information needed by TO Managers, as well as the information available for inclusion. Other considerations were the arrangement and organization of the document for maximum usefulness, the optimum level of presentation, features to preclude premature obsolescence, and the manner of production.

Based on those considerations and the data developed during the project, it was concluded that the guidebook must be both a practical guide and a reference document. It must deal with both the normal process of TO development and acquisition and, separately, with the considerations for selection of format-based techniques. Only that information which is verifiable as to accuracy should be incorporated. The information should be presented in a manner that assists the TO Manager with decisionmaking, but does not limit that decision capability. And, finally, the guidebook should be produced in such a way that periodic revisions and updates will be practical.

4.2 OVERVIEW

The guidebook has been prepared, in two volumes, to be a basic reference publication. It is intended for use by all individuals involved in the acquisition and management of Air Force TOs, with emphasis on the responsibilities and concerns of the TOMAs in those commands acquiring TOs. The scope includes a review of the Air Force TO System, extensive descriptions of procedural data formats, guidance for determining formats to satisfy particular user needs, and discussion of various aspects of TO procurement, development, and management.

4.3 GUIDEBOOK SCOPE AND ORGANIZATION

4.3.1 SCOPE. *The TO Managers handbook deals with two principal topics of significance to the* TO Specialist or Manager:

a. The Air Force TO acquisition cycle, including responsibilities, methods, and data;

b. The types and characteristics of procedural data formats to be considered for use in Air Force maintenance manuals, and guidance in selection of the most appropriate techniques.

Other topics are frequently mentioned, but are peripheral to these two central issues.

4.3.2 **ORGANIZATION.** The guidebook for TO Managers is organized into two volumes, as shown in Table 4-1. AFHRL-TR-80-50 comprises the basic text, and consists of 14 sections. AFHRL-TR-80-51 contains 10 sections of reference data and supplementary materials. The two volumes may be used together, or may be used independently. Some data are duplicated in the two volumes to support their independent use.

Table 4-1.—Organization and Contents of the TO Managers Guidebook

AFHRL-TR-80-50 : Technical Order Management and Acquisition

	Section	
General Information	1.	Overview
	2.	The Air Force Technical Order System
Format	3.	Maintenance Procedure Format Options—General
	4.	Format Options: Job Performance Aid Systems
	5.	Format Options: Primary Formats and Formats
	6.	Format Option Selection Guidelines
	7.	Familiarization of Users With New Formats
TO Acquisition	8.	Technical Order Requirements Determination
	9.	Technical Order Acquisition Management
	10.	Quality Assurance of Technical Orders
	11.	Technical Order Publication, Distribution, and Revision
Bibliography, Glossary, and Index	12.	Bibliography of Reference Publications
	13.	Acronyms and Abbreviations
	14.	Topical Index

AFHRL-TR-80-51: Technical Order Managers Reference Data

	Section	
Glossaries	1.	Glossary of Terms
	2.	Abbreviations and Acronyms
JPA and Format Data	3.	Job Performance Aid Research and Development
	4.	Job Performance Aid Concepts and Techniques
	5.	Format Test and Evaluation Data
	6.	Format Option Selection Data
Specifications and Standards	7.	Technical Manual Requirements and Guidelines Documents
	8.	Requirements Documents Cross-Reference Tables
	9.	Evaluation of Military Technical Manual Specifications
Bibliography and Index	10.	Bibliography of Reference Publications
	11.	Topical Index

4.4 GUIDEBOOK CONTENTS

4.4.1 AFHRL-TR-80-50—TECHNICAL ORDER MANAGEMENT AND ACQUISITION

4.4.1.1 General Information: Sections 1 and 2 contain general information about the document and the Air Force TO System.

- *Section 1: Overview* describes the purpose and objectives of the handbook, explains its organization and contents, and recommends approaches to effective ways to use it as an aid in solving some TO acquisition and management problems.
- *Section 2: The Air Force TO System* presents a concise description of the AFTO System, consolidates the requirements and guidance of the primary TO policy and regulatory publications, and describes the role of the Air Force TO Manager.

4.4.1.2 Technical Order Format Considerations: The next five sections of this volume are directed toward explaining the "format issue" for purposes of TO acquisition and management.

- *Section 3: Maintenance Procedure Format Options—General* provides a brief discussion of the background of procedural data format research, and the status of such research today. Types of formats are described and examples are provided of how use of various format-based techniques can help solve specific procedural data problems. A general orientation to the format-descriptive information in Sections 4 and 5 is also provided, as well as an overview of the conventional TO.
- *Section 4: Job Performance Aid (JPA) Systems* presents a comprehensive description of a selection of format-based techniques at the JPA System level. This includes, for each technique, a narrative description with accompanying illustrations, a hierarchical breakdown, format option characterizations, results of tests and experiments involving the method, and identification and description of specifications or other preparation/acquisition guidelines which are available. References to sources of additional information about each method are provided.
- *Section 5: Format Options: Primary Formats and Formats* presents a comprehensive description of several format-based techniques at the Primary Format and Format levels. These techniques are either independent of JPA Systems or are used in a number of different systems. Data presented are similar to those in Section 4.
- *Section 6: Format Option Selection Guidelines* presents guidance for determining the format options which will best satisfy the needs of the user in a particular program and the specific format-based techniques which contain those format options.
- *Section 7: Familiarization of Users with New Formats* presents a discussion of the need for user acceptance of TOs if they are to be effective job aids, especially if a new or unusual format is involved. Methods are described which can be used to familiarize using personnel at all levels with the features of the TOs being provided. Guidance on implementation planning and conduct is also provided.

4.4.1.3 Acquisition and Management of TOs: This portion deals with the process of acquiring and managing Air Force TOs regardless of the particular format(s) selected. It covers in greater detail the AFTO System described in Section 2.

- *Section 8: Technical Order Requirements Determination* describes how TO requirements are identified, the types of data which must be considered, the potential sources of such data, and how differences in the data will affect the types, organization, and numbers of TOs to be provided.
- *Section 9: TO Acquisition Management* provides guidance in the preparation of work statements and planning documentation and in the interpretation and selection of specifications. Suggestions for contractor proposal evaluation are included. Emphasis in this section is on the need to effectively document the needs of a program and evaluate the contractor's response.
- *Section 10: Quality Assurance of TOs* describes the reviews which should occur at various points in the development of TOs, including validation and verification. A composite checklist of review criteria is included. Guidance is also provided regarding coordination with and utilization of organizations and personnel outside of the TO acquisition organization to provide review assistance, and regarding planning for and conduct of TO verification. Special attention is given to the two-step verification process.
- *Section 11: TO Publication, Distribution, and Revision* reviews the requirements for printing, distribution, and revision of TOs. Coverage begins with the initial planning activities, continues through actual delivery to using commands and other agencies, and concludes with utilizing inputs from field activities to upgrade TO quality and providing feedback to TO users who have made suggestions and recommendations.

4.4.1.4 Bibliography, Glossary, and Index:

- *Section 12: Bibliography of Reference Publications* contains full bibliographic citations, in numerical order, for all publications referenced elsewhere in the handbook, as well as to other reports and papers that could assist interested TO Managers in increasing their understanding of format-based techniques.
- *Section 13: Acronyms and Abbreviations* is a comprehensive listing of abbreviations and acronyms, with the full title supplied, along with a notation as to whether the abbreviation is one of the many JPA techniques.
- *Section 14: Topical Index* is a detailed index to all significant topics and entries in AFHRL-TR-80-50.

4.4.2 AFHRL-TR-80-51—TECHNICAL ORDER MANAGERS REFERENCE DATA. AFHRL-TR-80-51 contains 10 sections of reference data and supplementary information.

4.4.2.1 Glossaries: Materials are presented, in two sections, that will aid the TO Manager in understanding terminology. Section 1 is a Glossary of Terms which may be encountered during TO acquisition and development, and includes terms used by the Air Force and other military services. Section 2 is a comprehensive listing of abbreviations and acronyms, with the full title supplied, along with a notation as to whether the abbreviation is one of the many JPA techniques.

4.4.2.2 JPA and Format Data: Reference information on formats and JPAs is presented in four sections. Section 3 provides a discussion of the background of format and JPA research, including format development, test and evaluation, and selection techniques. Section 4 identifies the population of JPAs which have been proposed for use at various times, their origins, the basic character of each, their development status, and the results of the consideration of their incorporation. Section 5 presents summaries and excerpts from various research reports concerning the testing and evaluation of format-based techniques. To the extent available, the discussion covers study objectives, methods, and approaches, and both quantitative and qualitative results. Section 6 contains tables which may be locally reproduced for use in determining optimum maintenance action system conditions and in selecting format options, according to the guidelines in AFHRL-TR-80-50, Section 6.

4.4.2.3 Specifications and Standards: This is a compilation of data in table and chart form regarding the specifications, standards, and other requirements and guidelines documents that are available for use in the acquisition and preparation of technical manuals. Section 7 contains a comprehensive listing of requirements and guidelines documents that are available for use in the preparation and acquisition of technical manuals and related data. Publications from both military and non-military sources are included. Section 8 provides a cross-reference between AFADs used for TO procurement and the specifications and standards which they reference or incorporate. This section also contains tabular results of an evaluation (*Ref. 5*) of Army, Navy, and Air Force Technical Manual Specifications.

4.4.2.4 Bibliography and Index: Section 9 contains full bibliographic citations, in both numerical and alphabetical order, for all publications referenced elsewhere in the handbook, as well as to other reports and papers that could assist interested TO Managers in increasing their understanding of format-based techniques. Section 10 is an index to all major topics in AFHRL-TR-80-51.

SECTION 5. CONCLUSIONS AND RECOMMENDATIONS

5.1 THE GUIDELINES

5.1.1 PATTERNS OF USE. This report has been prepared with the goal of serving as a valuable aid to individuals involved in all aspects of TO acquisition, development, and management. Inevitably, with such a broad target population, the value of the document will vary according to the past experience, levels of expertise, and program needs of each individual. TO Managers with limited experience should derive the greatest benefit. For these individuals, all parts of AFHRL-TR-80-50 can serve as a text for their profession and as a practical aid in overcoming the problems of their new assignments. Having this knowledge will not be a substitute for experience as a TO Specialist or Manager, but it will help avoid some of the pitfalls of TO acquisition and management that the experienced individual has already faced.

The experienced TO Specialist will very likely not derive the same benefits. Since this user has already served in a TO program capacity, some materials will be familiar. On the other hand, the discussions and descriptions regarding formats may be as new as to the experienced individual. As a desk reference, the materials in AFHRL-TR-80-50, Sections 4 and 5, together with the data in AFHRL-TR-80-51, should be of value to both the experienced and inexperienced individual.

5.1.2 CONVERSION TO FORMAL HANDBOOK. When, and if, the Technical Reports that resulted from this project are converted to a formal Handbook, the following recommendations should be implemented:

- The Handbook should be published under the authority of *both* the Systems Command and the Logistics Command, or higher authority. We believe this is necessary so that it is recognized by all TO Managers as representing the interests and points of view of *both* commands.
- The Handbook should be a loose-leaf document. Revisions and updates should be planned on at least an annual cycle. This will permit the Handbook to be kept reasonably current, reflecting changes in JPA format technology, as well as tracking changes in specifications, Air Force policy, regulations, and procedures. This approach will help avoid rapid obsolescence of the Handbook, increasing the probability of its continued use.
- Each section in the Handbook should be separated by labeled tab dividers, to assist the user in locating the particular item of information being sought.
- Illustrations should be in color if the subject of the illustration—such as a particular format—would normally require the use of color. Several of the JPA Systems recommended use color coding and color shading, and they cannot be adequately illustrated without the use of color.

5.2 OTHER FACTORS

In the process of conducting the analysis and preparing the guide, several other items of significance were identified that are beyond the scope of the current project for resolution.

a. The present ambiguity regarding responsibilities for various aspects of TO *acquisition* increases the difficulties of an already difficult task; inappropriate and/or poor quality TOs often result.

b. TO Managers are or should be professionals. A career field should be established, and a mandatory training course implemented. The currently planned training course, which has been promoted by serious TO Specialists for almost 10 years, should be implemented as soon as possible.

c. The AFTO-22 TO Improvement Reporting System enjoys the unique distinction of practically no differences of opinion. It was consistently identified as requiring improvement, particularly in the level of responsiveness to change requests and in providing feedback to the requesting organization and individual. Introduction of the AFTO-27 Publication Change Request (PCR) and the two-step verification process may eliminate the sources of some of the complaints, but the system itself appears in need of streamlining.

d. As mentioned earlier, TO-related AFADs are seriously out of date. The revision cycle should be changed to keep these key documents from being obsolete.

e. Finally, all activities related to the acquisition and maintenance of TOs should be clearly identifiable on a cost basis. At present, no one really knows what the TOs for a particular program cost; life-cycle cost comparisons of various formats are not possible.

The authors believe that the five recommendations listed here are deserving of the active support of AFLC and AFSC, particularly AFHRL.

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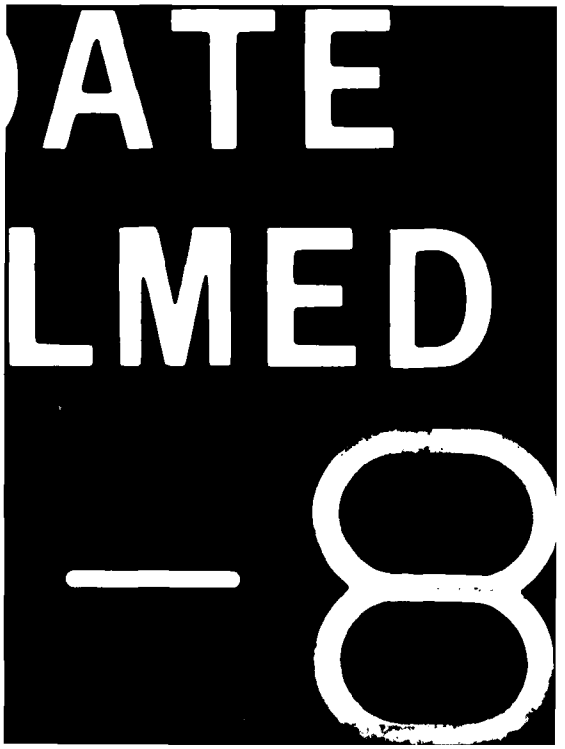
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